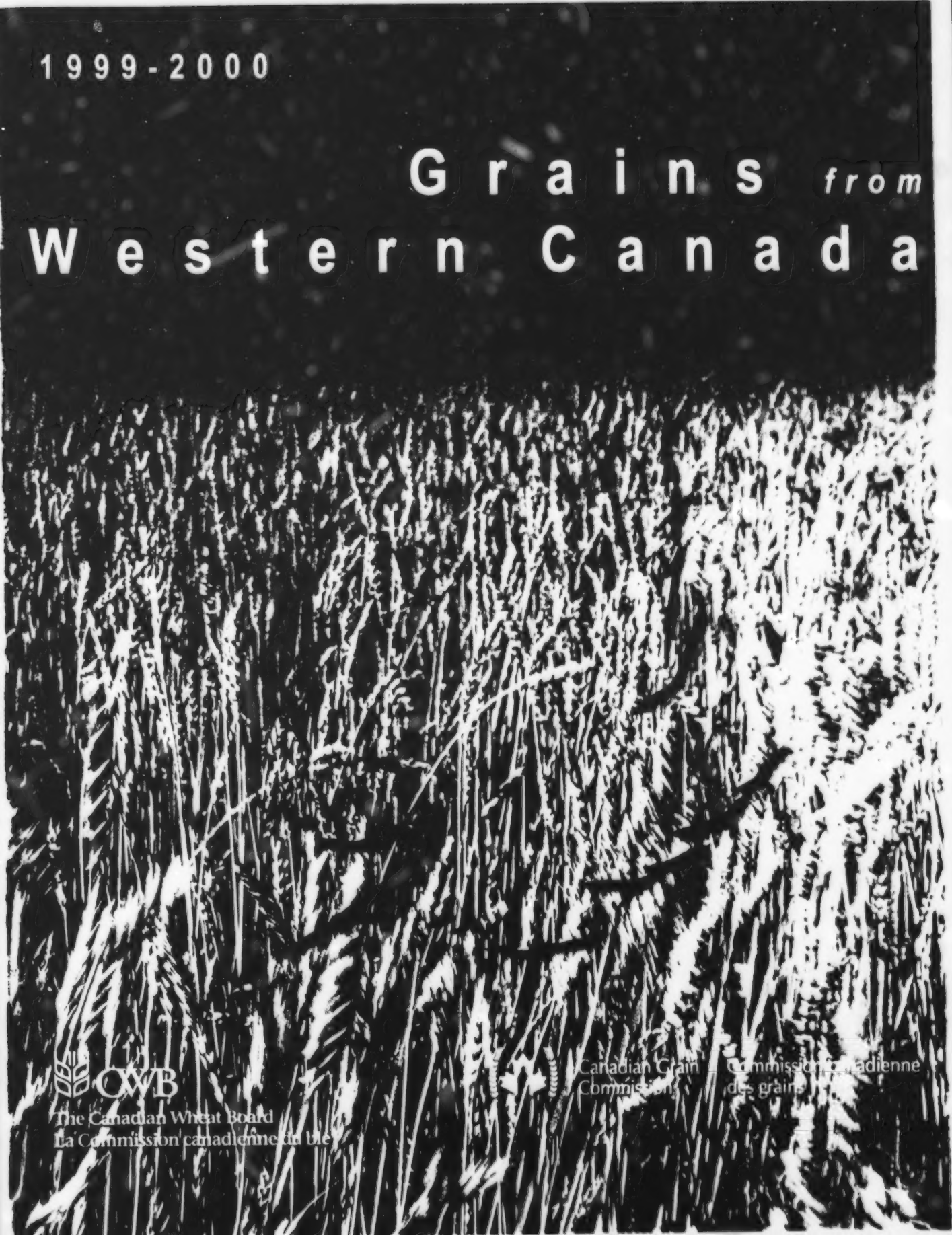
1999-2000

Grains *from* Western Canada



CWB

The Canadian Wheat Board
La Commission canadienne du blé

Canadian Grain Commission
Commission canadienne des grains

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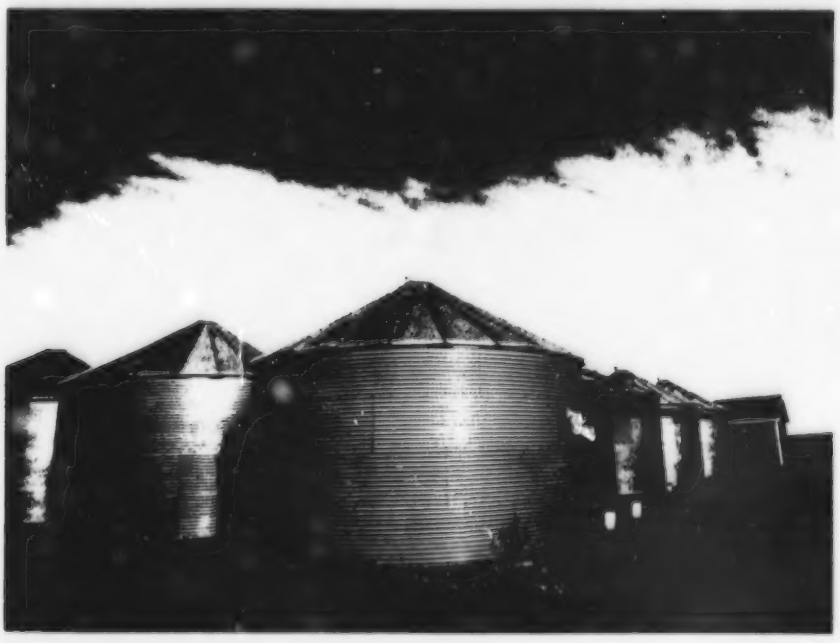


New **durum processing facility** at CIGI

The CWB and the Canadian International Grains Institute (CIGI) are taking a major step forward to provide even better service to durum customers.

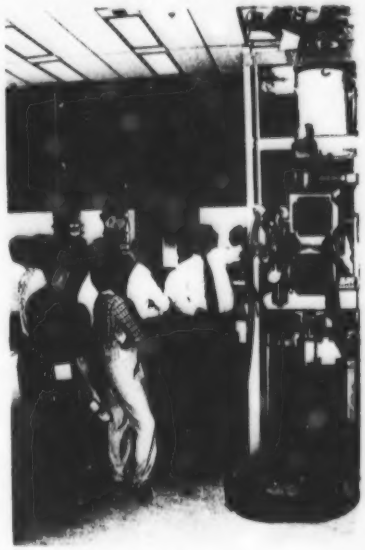
"We are excited to announce that sophisticated new durum and pasta processing equipment has been added to CIGI's technical facilities," said Greg Arason, President and CEO of the CWB.

CIGI is an instructional facility located in Winnipeg which offers courses in grain handling, marketing and technology. The facilities already include classrooms, a quality control laboratory, a pilot flour mill and a secondary processing area containing a pilot bakery and a pilot noodle plant.

The CWB has purchased a Bühler 300 kilos/hour "Polymatik" pasta press and a static dryer using "turbo-thermatic" drying technology to supplement CIGI's technical capabilities. This equipment is now operating at the CIGI facility.

To complement the pasta equipment's versatility, the CWB has also purchased Bühler "New Tronic" roll stands to expand the capabilities of the CIGI flour mill. The new mill will be able to produce any specified semolina granulation for testing and to replicate customers' practices better.

The increasing use of durum in pasta production around the world is the major reason for the CWB's significant investment in the pasta equipment and mill renovation. With this facility in place, the CWB will be able to offer greater customer support to durum processors. CIGI will also be able to use the equipment to simulate pasta-making processes from various countries, including where common wheat flour is blended with durum semolina to make pasta.

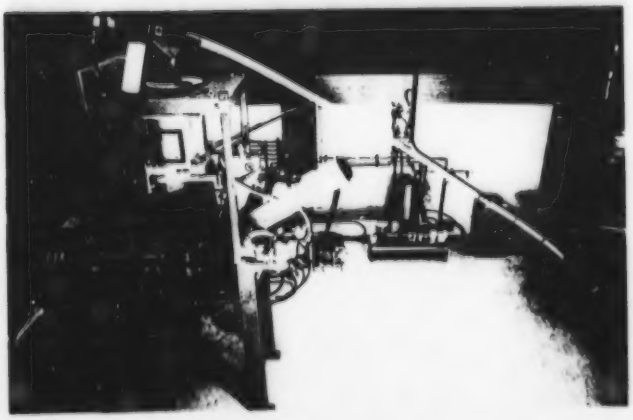


Earl Geddes, Program Manager in the CWB's Market Development department says with this technology the CWB will be able to more closely simulate the processing conditions and formulations of customers and provide advice to these customers on how to maximize the value of Canadian durum in their pasta production processes.

"We can also evaluate the many new durum varieties being developed in Canada to assure that only those varieties with the greatest processing value are registered for production," says Geddes.

"This new equipment will enable the CWB to continue to provide top quality durum to our customers as well as the technical support to assist them in maximizing the value of this durum in their plants."

Global customers of Western Canadian durum farmers will be able to work with the CWB and CIGI to develop products using Canadian durum to expand their pasta markets. This equipment will also enhance the technical programming for CIGI's International Durum Course and related programs.



Grains from Western Canada

Seeding

The 1999 growing season started earlier than normal in parts of the prairies as warmer than normal temperatures in the second half of April encouraged planting. The warm, dry conditions continued into the first week of May and some regions (especially southern Alberta and southeastern Manitoba) managed to seed most of their cereal crops by this time. This was not the case for the rest of the prairie region, especially eastern Saskatchewan and western Manitoba, where seeding was delayed by heavier than normal snow cover and excessive soil moisture levels. May precipitation over most of the southern and central Prairies was significantly above normal, while amounts in northern regions were closer to normal. Temperatures in May also turned cooler with most Prairie locations reporting deviations of 1-2 degrees Celsius below normal. These conditions slowed seeding progress and resulted in serious planting delays. The wet conditions continued through the first half of June, which resulted in the eventual abandonment of cropland in southwestern Manitoba and southeastern Saskatchewan. As a result of the prolonged seeding period, crop development stages varied greatly throughout the growing season.

Growing Season

The wet conditions persisted through June across most of the Prairies. In areas where crops were planted and emerging, these soil moisture levels resulted in above average stands with excellent yield potential. Later seeded crops had greater difficulty in handling the excess moisture, and the resulting stands were poorer than the earlier seeded crops. The frequent rainfall pattern continued through July which helped maintain crop conditions. Temperatures remained cooler than normal through June and July, with stations reporting monthly averages ranging from 0.5°C to 3.0°C below normal. The coolest temperatures were reported in the western regions of the Prairies during June and July. August brought a change in the weather as rains generally tapered off and temperatures climbed to normal or above normal across the Prairies. The warm temperatures helped encourage crop development, although most regions were still 10 to 15 days behind normal development at the end of the month.

The only exception to the wetter than normal conditions in June and July was the Peace River region of Alberta. This region received below normal precipitation during June, which caused stress to developing crops. Dry conditions persisted in the region through July and August which cut yields significantly.

Harvest

The lateness of the crop across the prairie region raised concerns about the potential for severe quantity or quality loss due to frost. The first sub-zero temperatures were reported in the foothills of southern and central Alberta and east-central Alberta during the first week of September. During the same week parts of northern and west-central Saskatchewan reported light frosts. The remainder of the Prairies did not report freezing temperatures until the second half of September. During the same week parts of northern and west-central Saskatchewan reported light frosts. The remainder of the Prairies did not report freezing temperatures until the second half of September. In most regions, the first frost in 1999 was very close to or after the average frost date for the region.

Mean protein content of milling grades of western Canadian wheat classes

Class	Protein content (%)[1] 1999
CWRS	13.3
CWAD	11.9
CWRW	10.0
CPSR	11.2
CPSW	10.9
CWES	12.2
CWSWS	10.7

[1]mean value, Nx5.7; 13.5% moisture content basis

Harvest began in southeastern Manitoba and southern Alberta by the middle of August, but these regions were the exception rather than the rule. The bulk of the western Canadian harvest started in September and finished in October. Precipitation during September and October was below normal, especially in the western half of the Prairies. This helped maintain the quality of grain, despite the prolonged harvest. The

Coverage of the 1999 harvest

eastern half of the Prairies received normal to above normal precipitation during September and October, which resulted in some deterioration of crop quality.

Production, Yields and Quality*

Production estimates for prairie grain production are above normal due to near record or record yields reported for the crops. Spring wheat and canola yields are expected to reach record levels at 2.4 tonnes per hectare and 1.6 tonnes per hectare, respectively. Rye yields are also expected to reach record levels (2.3 tonnes per hectare). Durum and barley yields are expected to be the second highest on record at 2.3 and 3.2 tonnes per hectare, respectively. Total wheat production for western Canada is estimated at 24.3 million tonnes with spring wheat 82 percent (20 million tonnes) of the total. Durum production is estimated at 4.0 million tonnes while barley production is expected to reach 12.0 million tonnes. The estimated production of the six major grains for Western Canada is 49.6 million tonnes, which would be the fifth largest production on record.

The grade pattern of the 1999 crop is lower than the exceptional results achieved in 1998, but still very close to the long term averages for both spring wheat and durum. The wet growing season did result in some downgrading due to disease (ergot and fusarium) and insect damage (wheat midge), especially in the eastern growing areas of the Prairies. The late harvest also resulted in downgrading due to frost. In barley, ample moisture during the growing season and relatively cool temperatures resulted in good kernel plumpness and lower protein levels. These moist, cool conditions combined with the late harvest to cause some downgrading due to poor visual kernel characteristics (staining) and disease.

* Source: Statistics Canada Field Crop Reporting Series Number 7, October 8, 1999

Canada Western Red Spring Wheat

Canada is the world's largest exporter of hard red spring wheat. Canada Western Red Spring (CWRS) wheat is well known for its excellent milling and baking qualities with low protein loss during milling.

Flour from CWRS wheat is well regarded for the production of high-volume pan breads. Since wheat in this class has good gluten strength, it is also used extensively either alone or in blends with weaker wheats for the production of a diverse range of products such as hearth breads, noodles, flat breads and steam breads.

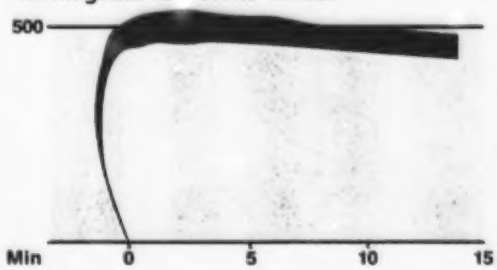
This class of wheat is marketed in three separate milling grades. The top two grades, No. 1 CWRS wheat and No. 2 CWRS wheat, are further segregated by protein level with guaranteed minimum protein contents. The segregations for each crop year vary depending on crop conditions and customer demand.

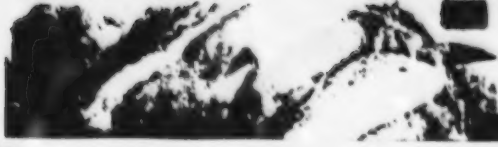
Flours milled from the top grades are characterized by strong yet mellow gluten properties and very high water absorption potential. The top grades also exhibit sound characteristics with low alpha-amylase activity and correspondingly high wheat falling number and flour amylograph peak viscosities.

Export standards for CWRS wheat

		Maximum limits of			
		Foreign material		Wheat of other classes	
Grade name	Minimum test weight (kg/hL)	Matter other than cereal grains	Total including cereal grains	Contrasting classes	Total including contrasting classes
1CWRS	79.0	0.2%	0.4%	0.5%	1.5%
2CWRS	77.5	0.2%	0.75%	1.5%	3.0%
3CWRS	76.5	0.2%	1.25%	2.5%	5.0%

Farinogram for CWRS wheat





No. 1 Canada Western Red Spring Wheat quality data

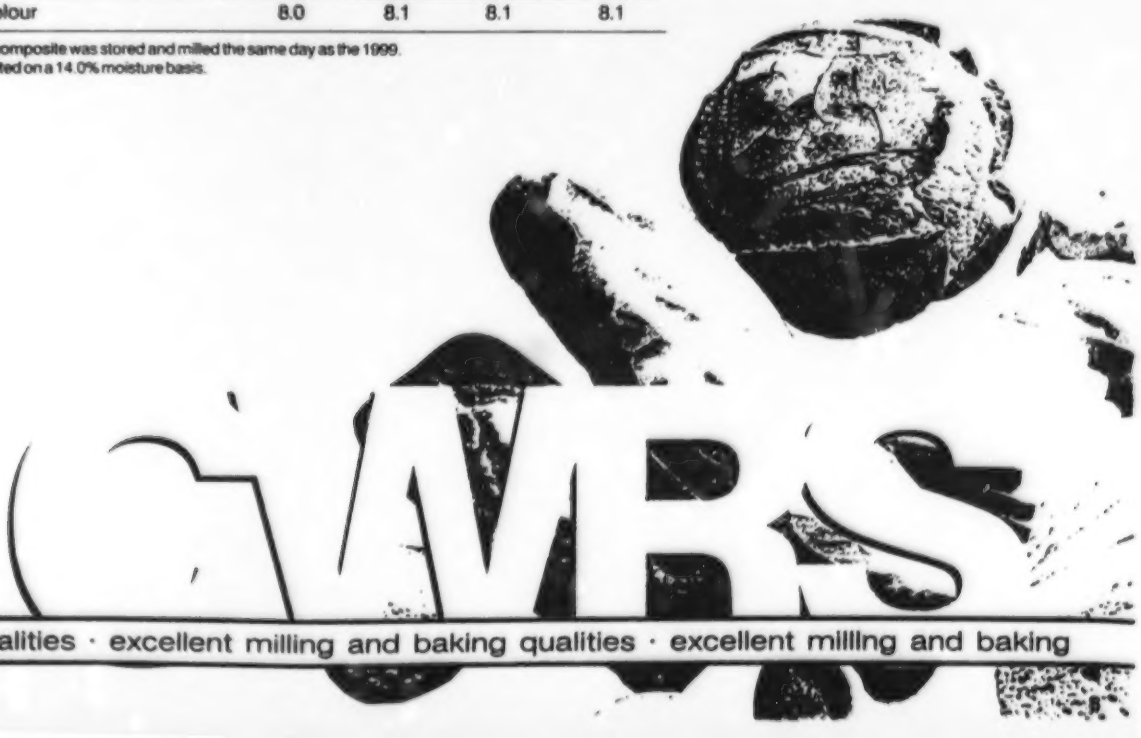
Quality parameter*	1999 Minimum protein content 14.5	13.5	12.5	No. 1 CWRS 13.5 1998	1989-98 Mean
Wheat					
Test weight, kg/hL	81.5	82.0	82.4	81.5	81.1
Weight per 1000 kernels, g	33.5	34.9	33.7	31.8	31.4
Protein content, %	14.7	13.7	12.7	13.7	13.7
Protein content, % (dry matter basis)	17.0	15.8	14.7	15.8	15.8
Ash content, %	1.54	1.58	1.58	1.53	1.55
α-amylase activity, units/g	3.5	3.5	4.0	2.5	4.6
Falling number, s	370	385	375	395	395
PSI,%	55	53	52	52	52**
Milling					
Flour yield					
Clean wheat basis, %	75.2	75.6	75.3	75.8	75.6
0.50% ash basis, %	78.2	77.6	77.8	75.3	76.1
Flour					
Protein content, %	14.1	13.0	12.0	13.1	13.1
Wet gluten content, %	40.0	36.4	33.2	35.5	38.4
Ash content, %	0.44	0.46	0.45	0.51	0.49
Grade colour	-1.8	-2.0	-2.1	-1.7	-1.3
AGTRON colour, %	71	76	77	69	70***
Starch damage, %	6.9	7.3	7.4	6.9	6.8
α-amylase activity, units/g	1.0	1.0	1.0	0.5	1.3
Amylograph peak viscosity, BU	720	725	720	730	690
Maltose value, g/100 g	2.2	2.4	2.5	2.2	2.1
Farinogram					
Absorption, %	66.9	66.4	65.4	65.1	65.3
Development time, min	6.25	5.25	5.25	5.0	5.0
Mixing tolerance index, BU	25	30	30	25	25
Stability, min	10.5	10.0	8.0	9.5	10.0
Extensogram					
Length, cm	22	21	20	22	22
Height at 5 cm, BU	335	305	320	290	287
Maximum height, BU	620	575	570	525	493
Area, cm^2	175	160	150	160	146
Alveogram					
Length, mm	126	104	98	108	124
P (height x 1.1), mm	122	128	126	107	104
W, x 10^{-4} joules	530	468	432	396	415
Baking (Canadian short process baking test)					
Absorption, %	70	70	69	69	69
Mixing energy, W-h/kg	13.0	13.8	14.7	10.6	8.2
Mixing time, min	9.1	9.4	9.9	8.0	7.5
Loaf volume, cm^3/100 g flour	1160	1100	1010	1065	1100

*Unless otherwise specified, data are reported on a 13.5% moisture basis for wheat and a 14.0% moisture basis for flour.
**Mean of data generated starting in 1990
***Mean of data generated starting in 1993

No. 1 Canada Western Red Spring Wheat 13.5% protein segregate
Comparative tandem Bühler pilot mill flour data

Quality parameter[2]	Straight-grade 1999	Straight-grade 1998	Patent 1999	Patent 1998
Flour				
Yield, %	75.1	74.7	45.0	45.0
Protein content, %	13.1	13.1	12.3	12.6
Wet gluten content, %	35.9	35.0	33.6	33.7
Ash content, %	0.43	0.47	0.36	0.38
Grade colour	-2.0	-2.1	-3.4	-3.3
AGTRON colour, %	74	78	87	86
Amylograph peak viscosity, BU	765	800	825	875
Starch damage, %	6.1	6.0	6.6	6.5
Farinogram				
Absorption, %	63.3	62.4	62.6	62.1
Development time, min	4.75	4.5	5.0	4.25
Mixing tolerance index, BU	35	25	25	20
Stability, min	8.0	8.5	11.0	20.0
Sponge and dough baking test	(40 ppm ascorbic acid)		(20 ppm ascorbic acid)	
Absorption, %	65	64	65	64
Mixing/energy (dough stage), W-h/kg	8.3	8.5	8.4	9.9
Mixing/time (dough stage), min	7.8	8.1	8.9	9.5
Loaf volume, cm^3/100 g flour	1130	1120	1075	1060
Appearance	7.6	7.8	7.7	7.8
Crumb structure	6.0	6.0	6.0	6.2
Crumb colour	8.0	8.1	8.0	8.1
Canadian short process baking test	(150 ppm ascorbic acid)		(150 ppm ascorbic acid)	
Absorption, %	67	66	67	66
Mixing/energy, W-h/kg	12.8	14.1	14.4	11.7
Mixing/time, min	8.9	9.5	10.1	8.5
Loaf volume, cm^3/100 g flour	1060	1070	1070	1095
Appearance	7.8	8.0	7.4	8.0
Crumb structure	6.0	6.2	6.2	6.0
Crumb colour	8.0	8.1	8.1	8.1

[1] The 1998 composite was stored and milled the same day as the 1999.
[2] Data reported on a 14.0% moisture basis.



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Canada Western Red Spring Wheat

No. 2 Canada Western Red Spring 13.5 Wheat quality data

	1999 Minimum protein content			No. 2 CWRS 13.5	
Quality parameter*	14.5	13.5	12.5	1998	1989-98 Mean
Wheat					
Test weight, kg/hL	81.3	81.8	82.1	80.7	79.3
Weight per 1000 kernels, g	33.8	33.7	32.9	32.0	31.6
Protein content, %	14.7	13.7	12.7	13.6	13.7
Protein content, % (dry matter basis)	17.0	15.8	14.7	15.7	15.8
Ash content, %	1.65	1.63	1.61	1.63	1.61
α-amylase activity, units/g	9.0	5.5	5.0	7.0	10.3
Falling number, s	370	385	380	385	371
PSI,%	55	53	53	54	54**
Milling					
Flour yield					
Clean wheat basis, %	75.2	75.4	74.7	75.5	75.4
0.50% ash basis, %	76.7	76.4	76.7	75.0	75.9
Flour					
Protein content, %	14.0	13.1	12.0	13.0	13.1
Wet gluten content, %	40.1	37.4	33.8	35.9	38.1
Ash content, %	0.47	0.48	0.46	0.51	0.49
Grade colour	-1.5	-1.7	-2.2	-1.5	-1.0
AGTRON colour, %	72	73	79	69	69***
Starch damage, %	6.1	6.4	6.7	6.8	6.6
α-amylase activity, units/g	2.5	2.0	2.0	1.0	3.0
Amylograph peak viscosity, BU	685	710	725	670	528
Maltose value, g/100 g	2.0	2.1	2.1	2.3	2.1
Farinogram					
Absorption, %	65.5	64.9	64.4	65.5	65.0
Development time, min	6.25	5.25	5.0	4.5	4.75
Mixing tolerance index, BU	35	30	30	30	30
Stability, min	9.5	8.0	8.0	8.0	9.0
Extensogram					
Length, cm	23	22	20	23	23
Height at 5 cm, BU	310	310	310	255	276
Maximum height, BU	565	555	550	445	467
Area, cm^2	170	165	150	135	144
Alveogram					
Length, mm	134	122	98	106	127
P (height x 1.1), mm	99	106	114	106	99
W, x 10^{-4} joules	441	425	400	394	400
Baking (Canadian short process baking test)					
Absorption, %	70	69	68	69	69
Mixing energy, W-h/kg	17.0	14.0	13.1	11.4	8.1
Mixing time, min	11.5	9.6	9.2	7.7	7.5
Loaf volume, cm^3/100 g flour	1095	1040	1020	1045	1099

*Unless otherwise specified, data are reported on a 13.5% moisture basis for wheat and a 14.0% moisture basis for flour.
**Mean of data generated starting in 1990
***Mean of data generated starting in 1993

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Canada Western Amber Durum Wheat

Canada markets two-thirds of the world's durum wheat. Canada Western Amber Durum (CWAD) wheat is grown in the drier regions of the western Prairies. Significant efforts have been made by breeders to develop superior varieties that are well adapted to the environmental conditions of these regions and that have specific applications for use in pasta products. These breeding advances, along with well-developed production technology, combine to produce a high quality product.

Durum wheat is milled into a relatively coarse, granular material called semolina, an intermediate product of the common wheat milling process. Granular semolina is the preferred product for high quality pasta production, so it is desirable for the miller to have a wheat that will yield the maximum quantity of semolina and a minimum of lower quality flour. Better grades of CWAD wheats have high levels of hard vitreous kernels that will yield a high percentage of excellent quality semolina. This product possesses the high yellow pigment content necessary to produce products with bright yellow color. It also has the strong, extensible gluten necessary to ensure good cooking characteristics.

Although the majority of CWAD wheat is used for pasta products, it is also used to produce high quality couscous which is a staple in most parts of North Africa. CWAD wheat will produce a uniform, granular and bright yellow semolina which is the desired raw material for couscous. Flour from durum wheat is also used to make bread in some areas of Europe and North Africa.

Export standards for CWAD wheat

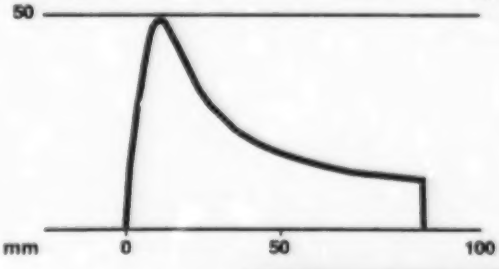
		Maximum limits of			
		Foreign material		Wheat of other classes	
Grade name	Minimum test weight (kg/hL)	Matter other than cereal grains	Total including cereal grains	Contrasting classes	Total including contrasting classes
1CWAD	80.0	0.2%	0.5%	2.0%	3.0%
2CWAD	79.5	0.2%	0.8%	2.5%	5.0%
3CWAD	78.0	0.2%	1.0%	3.5%	7.0%
4CWAD	75.0	0.2%	3.0%	10.0%	15.0%

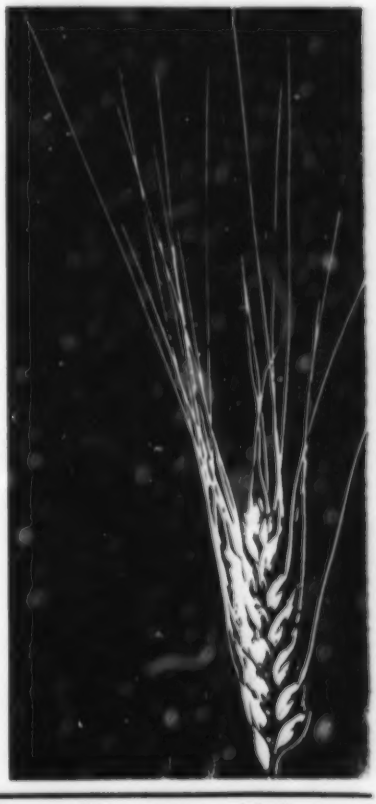
No. 1 and No. 2 Canada Western Amber Durum Wheat quality data*

Grade	No. 1 CWAD		No. 2 CWAD	
Quality parameter[1]	1999	1998	1999	1998
Wheat				
Test weight, kg/hL	83.4	82.3	83.2	81.3
Weight per 1000 kernels, g	43.0	40.7	44.5	40.4
Hard vitreous kernels, %	93	88	82	81
Protein content, %	12.2	12.5	11.9	12.4
Protein content, % (dry matter basis)	14.1	14.5	13.8	14.3
SDS sedimentation, mL	40	36	35	35
Ash content, %	1.58	1.65	1.66	1.66
Yellow pigment content, ppm	7.9	8.6	7.8	8.6
Falling number, s	415	435	385	400
Milling yield, %	73.2	73.2	74.0	73.3
Semolina yield, %	65.8	66.1	65.9	65.8
PSI, %	37	37	38	38
Semolina				
Protein content, %	11.1	11.4	10.8	11.3
Wet gluten content, %	29.0	30.1	28.0	30.2
Dry gluten content, %	10.1	10.4	10.0	10.5
Gluten index, %	26	42	25	40
Ash content, %	0.65	0.68	0.66	0.69
Yellow pigment content, ppm	7.4	8.1	7.2	8.0
AGTRON colour, %	81	82	80	81
Minolta colour:				
L*	88.0	89.0	87.7	88.7
a*	-2.9	-3.5	-3.0	-3.6
b*	31.7	34.8	30.7	35.3
Speck count per 50 cm^2	20	26	26	25
Falling number, s	490	530	450	485
Alveogram				
Length, mm	79	93	74	96
P (height x 1.1), mm	52	41	50	39
P/L	0.7	0.4	0.7	0.4
W x 10^{-4} joules	114	100	103	100
Spaghetti-dried at 70° C				
Minolta colour:				
L*	79.9	81.0	79.6	80.9
a*	2.0	0.1	2.5	0.1
b*	65.1	72.3	64.0	72.4
Cooking quality, CQP	28	34	29	31

[1]Unless otherwise specified, data are reported on a 13.5% moisture basis for wheat and a 14.0% moisture basis for semolina.

Alveogram for No. 1 CWAD wheat





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Canada Prairie Spring White Wheat

No. 1 Canada Prairie Spring White Wheat quality data

Quality parameter[1]	1999	1998
Wheat		
Test weight, kg/hL	81.4	80.8
Weight per 1000 kernels, g	35.2	35.7
Protein content, %	10.9	11.5
Protein content, % (dry matter basis)	12.6	13.3
Ash content, %	1.63	1.46
α-amylase activity, units/g	5.5	3.5
Falling number, s	400	400
Flour yield, %	74.4	77.0
PSI, %	57	59
Flour		
Protein content, %	9.9	10.6
Wet gluten content, %	27.9	29.5
Ash content, %	0.48	0.51
Grade colour	-2.2	-2.3
AGTRON colour, %	75	73
Starch damage, %	5.9	6.0
α-amylase activity, units/g	2.0	1.0
Amylograph peak viscosity, BU	780	835
Maltose value, g/100 g	2.1	2.0
Farinogram		
Absorption, %	61.5	60.7
Development time, min	2.75	3.0
Mixing tolerance index, BU	65	60
Stability, min	3.0	4.0
Extensogram		
Length, cm	22	23
Height at 5 cm, BU	185	190
Maximum height, BU	240	255
Area, cm^2	80	85
Alveogram		
Length, mm	106	118
P (height x 1.1), mm	71	66
W, x 10^{-4} joules	197	204
Baking (Remix-to-peak baking test)		
Absorption, %	58	56
Remix time, min	1.5	1.3
Loaf volume, cm^3/100 g flour	620	685

[1]Unless otherwise specified, data are reported on a 13.5% moisture basis for wheat and a 14.0% moisture basis for flour.

Canada Prairie Spring White (CPSW) wheat is a relatively new class of Canadian wheat which was introduced in 1989. It evolved through breeding programs and many years of research, development and commercial evaluation.

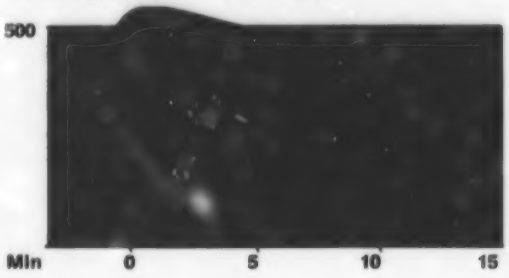
Wheats in this class have hard kernels and excellent milling characteristics. CPSW has medium dough strength properties and a protein content typically ranging from 11 per cent to 12 per cent (basis 13.5 per cent moisture), depending upon growing conditions.

Straight grade flours from this wheat are particularly suitable for many types of noodles, flat breads and all-purpose flours. The pale colour of the bran coat is especially desirable in noodle manufacture where visible bran specks are to be avoided. High extraction flours have found application in various types of flat breads and chapattis.

Export standards for CPSW wheat

		Maximum limits of			
		Foreign material		Wheat of other classes	
Grade name	Minimum test weight (kg/hL)	Matter other than cereal grains	Total including cereal grains	Contrasting classes	Total including contrasting classes
1CPSW	77.0	0.2%	0.75%	3.0%	5.0%
2CPSW	75.0	0.2%	1.5%	5.0%	10.0%

Farinogram for CPSW wheat



CPSW

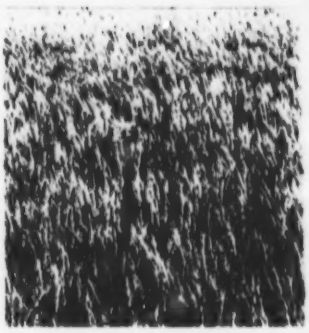
excellent milling characteristics · excellent milling characteristics · excellent milling characteristics

Canada Prairie Spring Red Wheat

No. 1 Canada Prairie Spring Red Wheat quality data

Quality parameter[1]	1999	1998
Wheat		
Test weight, kg/hL	81.6	81.1
Weight per 1000 kernels, g	39.6	39.5
Protein content, %	11.4	11.8
Protein content, % (dry matter basis)	13.2	13.6
Ash content, %	1.53	1.57
α-amylase activity, units/g	6.5	4.0
Falling number, s	345	375
Flour yield, %	74.1	76.2
PSI, %	55	57
Flour		
Protein content, %	10.6	11.1
Wet gluten content, %	28.8	29.4
Ash content, %	0.46	0.47
Grade colour	-2.2	-1.6
AGTRON colour, %	74	67
Starch damage, %	5.9	6.1
α-amylase activity, units/g	1.5	0.5
Amylograph peak viscosity, BU	675	760
Maltose value, g/100 g	2.0	1.9
Farinogram		
Absorption, %	60.6	60.7
Development time, min	4.75	5.0
Mixing tolerance index, BU	50	45
Stability, min	6.0	6.5
Extensogram		
Length, cm	21	22
Height at 5 cm, BU	285	315
Maximum height, BU	500	610
Area, cm^2	145	175
Alveogram		
Length, mm	138	135
P (height x 1.1), mm	80	76
W, x 10^{-4} joules	316	302
Baking (Remix-to-peak baking test)		
Absorption, %	59	60
Remix time, min	2.0	2.3
Loaf volume, cm^3/100 g flour	730	775

[1] Unless otherwise specified, data are reported on a 13.5% moisture basis for wheat and a 14.0% moisture basis for flour.



Canada Prairie Spring Red (CPSR) wheat was introduced in 1985 after many years of research, development and commercial evaluation. Breeding programs in western Canada have provided continuous improvements to the class. These include enhancement in quality factors such as flour yield, flour color, higher water absorption, somewhat stronger dough characteristics and better baking performance.

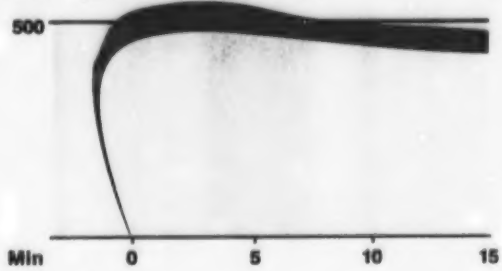
This wheat class has hard kernels and good milling characteristics. The kernels are only slightly softer than Canada Western Red Spring (CWRS) wheat.

CPSR has medium dough strength properties and a protein content that typically averages between 11.0 per cent and 12.0 per cent (basis 13.5 per cent moisture). The flour from this wheat is particularly suitable for French-style hearth breads. It can also be used alone or in blends to produce various types of flat bread, noodles, steam breads, pan breads, crackers and related products.

Export standards for CPSR wheat

		Maximum limits of			
		Foreign material		Wheat of other classes	
Grade name	Minimum test weight (kg/hL)	Matter other than cereal grains	Total including cereal grains	Contrasting classes	Total including contrasting classes
1CPSR	77.0	0.2%	0.75%	3.0%	5.0%
2CPSR	75.0	0.2%	1.5%	5.0%	10.0%

Farinogram for CPSR wheat



CPSR

· good milling characteristics · good milling characteristics · good milling characteristic

Canada Western Extra Strong Red Spring Wheat

Canada Western Extra Strong Red Spring (CWES) is a unique class of wheat that exhibits gluten strength and mixing characteristics that are stronger than other red spring wheat types. The principal variety of CWES wheat grown in western Canada is Glenlea.

CWES wheat has a somewhat harder kernel than wheat in the Canada Western Red Spring class. This means tempering times for CWES wheat should be somewhat longer to maximize milling performance and flour yield. An important difference of wheat in the CWES class is the extra strong physical dough properties. This is shown by extended farinograph development times and longer stability, even at lower protein levels. When testing a sample of 100 per cent CWES wheat in the laboratory, the farinograph speed must be increased from 63 RPM to 90 RPM in order to properly develop the doughs. Strong extensigraph curves are also a characteristic of CWES wheats.

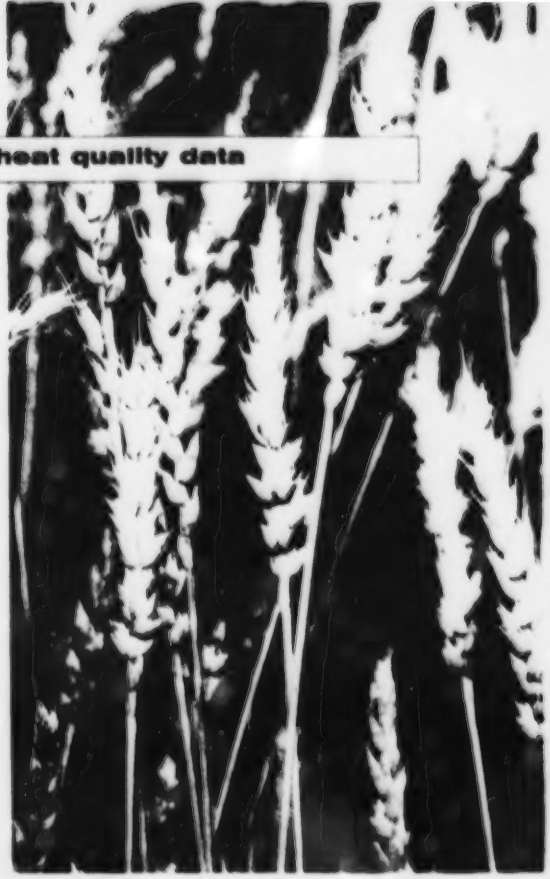
Flour from CWES wheat will display slightly higher ash levels compared to other red spring wheat types milled at the same extraction rates. This is due to the higher natural mineral content in the endosperm of the wheat and does not have a negative impact on the colour of the flour.

CWES wheat has been used as a blending wheat in order to provide stronger dough properties in the production of pan breads, hearth breads, buns and similar products. In addition, pilot and commercial scale testing have shown promising applications of CWES in blends for the production of whole wheat or specialty breads. These tests have shown that the use of white flour or whole wheat flour milled from CWES can allow a bakery to reduce, or even eliminate, the addition of vital wheat gluten in the manufacture of these breads. Gluten is normally added to provide the strength to carry the additional non-functional ingredients and achieve acceptable bread volume.

Another application of CWES wheat flour is for frozen bread doughs. The frozen dough industry has seen a rapid growth over the last decade and a challenge to this industry has been to provide a superior quality product that can maintain its bread making characteristics over a longer frozen storage period. Addition of CWES flours will provide increases in shelf life expectancy of frozen doughs, with excellent results when the product is thawed, proofed and baked.

CWES

· strong gluten wheat · strong gluten wheat · strong gluten wheat · strong gluten wheat · s



No. 1 Canada Western Extra Strong Red Spring Wheat quality data

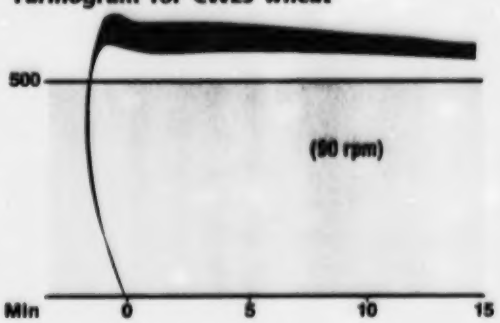
Quality parameter[1]	1999	1998
Wheat		
Test weight, kg/hL	81.3	79.6
Weight per 1000 kernels, g	42.1	41.0
Protein content, %	12.0	12.5
Protein content, % (dry matter basis)	13.9	14.5
Ash content, %	1.57	1.65
α-amylase activity, units/g	10.5	7.5
Falling number, s	350	355
Flour yield, %	75.5	76.3
PSI, %	48	47
Flour		
Protein content, %	11.2	11.8
Wet gluten content, %	27.4	27.6
Ash content, %	0.51	0.59
Grade colour	-1.6	-0.8
AGTRON colour, %	70	59
Starch damage, %	7.8	9.2
α-amylase activity, units/g	3.5	3.0
Amylograph peak viscosity, BU	505	480
Maltose value, g/100 g	2.9	3.2
Farinogram		
Absorption, %	62.9	64.6
Development time, min[2]	5.5	5.5
Extensogram		
Length, cm	23	23
Height at 5 cm, BU	335	355
Maximum height, BU	625	640
Area, cm^2	200	205
Alveogram		
Length, mm	77	69
P (height x 1.1), mm	121	127
W, x 10^{-4} joules	382	378
Baking (Remix-to-peak baking test)		
Absorption, %	64	64
Remix time, min	3.5	4.7
Loaf volume, cm^3/100 g flour	860	900

[1] Unless otherwise specified, data are reported on a 13.5% moisture basis for wheat and a 14.0% moisture basis for flour.
[2] At the normal Farinograph speed of 63 rpm, CWES flour does not develop and appears weak. Therefore Farinograph speed has been increased from 63 rpm to 90 rpm in order to achieve full development.

Export standards for CWES wheat

Grade name	Minimum test weight (kg/hL)	Maximum limits of Foreign material: Matter other than cereal grains	Foreign material: Total including cereal grains	Wheat of other classes: Contrasting classes	Wheat of other classes: Total including contrasting classes
1CWES	78.0	0.2%	0.75%	1.5%	3.0%
2CWES	76.0	0.2%	1.5%	2.5%	5.0%

Farinogram for CWES wheat



Canada Western Soft White Spring Wheat*

Canada Western Soft White Spring (CWSWS) wheat is grown under irrigation in the southern regions of the western Prairies. There are three milling grades in this class of wheat.

The top two grades of CWSWS have very good milling quality compared to other soft wheat types.

Flours produced from the top grades of CWSWS wheat have typical proteins in the range from 9 per cent to 10 per cent on a 14 per cent moisture basis. Typical of soft flours, the gluten properties are weaker and make them suitable for the production of cookies, pastries, biscuits and crackers. This wheat is also suitable either alone or in blends for the production of many types of flat breads, noodles, steam breads and dumplings.

Canada Western Red Winter Wheat*

Canada Western Red Winter (CWRW) wheat can be classified as a medium protein, strong wheat with hard kernel characteristics. Breeding programs in western Canada have provided continuous improvements to the class, in the area of yield and quality characteristics.

Both grades of CWRW have excellent milling quality and will give a high flour yield with very low ash and flour color values.

Flour produced from high grade CWRW wheat possesses strong gluten properties and is ideally suited for French-style hearth breads and many types of noodles. It can also be used for production of flat breads, steam breads and related products.

**Due to low production volume insufficient samples were received to be able to provide harvest survey data and analysis.*

Organic Grain

All classes of grain grown in western Canada are also grown as "organically" produced grain. All organic wheat, durum, feed and malting barley are grown from the same high quality varieties that are marketed through the CWB as conventional grains. The "organic" designation refers to grain that has been grown with limitations on the use of synthetically-produced fertilizers, pesticides and growth hormones. Details of organic certification are available from the various organic certification bodies. Contact the CWB for more information.

Noodles

Quality evaluations are carried out to determine the suitability of flours for processing into both white salted and yellow alkaline noodles. Information is provided on flour and noodle quality based on 60 per cent extraction flour prepared from the corresponding grade of Canadian wheat classes milled on the Grain Research Labortary's tandem Bühler pilot mill. All patent flours displayed high brightness comparable to the previous year with slightly higher yellow colour in their corresponding alkaline noodles.

Comparison of 1999 vs 1998 tandem Bühler pilot mill 60% patent noodle flours

	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Flour										
Protein content, %	12.7	12.6	11.8	11.7	12.7	12.7	11.8	11.8	9.5	10.1
Wet gluten content, %	35.3	34.5	32.0	31.5	35.5	35.1	31.9	31.7	27.4	28.0
Ash content, %	0.40	0.41	0.39	0.41	0.40	0.42	0.39	0.40	0.43	0.40
Grade colour	-2.9	-2.9	-3.2	-3.2	-2.8	-2.7	-2.9	-3.0	-3.2	-3.6
AGTRON colour, %	83	83	84	85	82	82	82	84	86	89
Starch damage, %	6.3	6.4	6.7	6.7	6.3	6.2	6.6	6.4	5.6	4.9
Alpha amylase activity, units/g	1.0	0.5	0.5	0.5	1.5	1.0	2.0	1.0	1.0	0.5
Amylograph peak viscosity, BU	790	855	795	830	705	800	655	780	880	970
Farinogram										
Absorption, %	62.5	62.3	62.2	61.5	62.4	62.2	62.1	61.6	59.0	57.9
Development time, min.	5.25	5.25	4.75	3.25	5.00	4.50	4.25	3.75	2.50	2.75
Mixing tolerance index, BU	25	20	30	25	30	25	35	25	75	55
Stability, min.	9.00	10.50	9.50	9.00	9.00	9.50	7.50	8.00	3.00	4.50
Fresh Alkaline Noodles:										
Sheeting energy (J/kg)	25.68	25.85	24.91	22.58	25.65	26.08	24.25	25.33	20.25	19.73
Raw Colour Raw 2 h (24 h)										
Brightness, L*	79.8 (75.0)	79.9 (74.9)	80.9 (76.5)	80.7 (76.1)	79.9 (74.8)	80.3 (75.3)	79.6 (75.1)	80.5 (76.2)	81.6 (76.0)	82.3 (77.2)
Redness, a*	0.59 (0.82)	0.43 (0.64)	0.40 (0.63)	0.33 (0.54)	0.56 (0.95)	0.27 (0.70)	0.44 (0.82)	0.18 (0.51)	-0.74 (-0.01)	-0.82 (-0.31)
Yellowness, b*	29.4 (29.5)	29.5 (29.3)	29.6 (30.2)	29.5 (29.9)	28.7 (29.4)	28.7 (29.6)	30.7 (30.7)	29.8 (30.1)	30.8 (29.8)	29.9 (29.5)
Cooked Colour										
Brightness, L*	65.4	65.4	65.2	65.6	65.6	65.3	64.8	64.6	64.6	67.3
Redness, a*	-1.22	-1.25	-1.39	-1.58	-1.16	-1.45	-1.05	-1.10	-1.73	-2.49
Yellowness, b*	27.0	26.9	28.3	27.6	26.8	26.7	27.2	27.3	30.2	29.5
Cook Time, minutes	11	11	10	9	11	10	11	11	9.5	8
Texture										
Thickness, mm	2.27	2.27	2.24	2.22	2.27	2.25	2.22	2.23	2.07	2.02
Resistance to compression, %	29.6	30.8	30.2	30.8	30.7	32.5	28.4	29.3	24.2	29.5
Recovery, %	33.6	34.2	32.1	34.0	33.4	33.9	31.9	32.1	25.3	30.0
MCS, g/mm²	23.4	24.2	22.6	23.6	23.9	24.6	21.2	22.0	17.3	20.4
Fresh White Salted Noodles:										
Sheeting energy (J/kg)	18.13	16.84	17.82	16.35	15.69	15.94	17.86	18.05	17.07	15.15
Raw Colour Raw 2 h (24 h)										
Brightness, L*	80.5 (75.6)	80.7 (75.4)	81.5 (76.5)	81.6 (76.5)	80.1 (74.6)	80.2 (75.7)	81.1 (76.1)	81.1 (76.5)	82.7 (75.4)	82.6 (77.6)
Redness, a*	2.82 (3.39)	2.85 (3.32)	2.68 (3.13)	2.64 (3.02)	2.82 (3.34)	2.72 (3.21)	2.62 (3.21)	2.61 (3.11)	2.07 (2.39)	1.98 (2.30)
Yellowness, b*	26.2 (26.5)	26.2 (26.2)	26.0 (26.0)	26.2 (25.8)	25.9 (25.9)	25.7 (25.9)	26.0 (26.0)	25.7 (25.9)	25.2 (24.3)	25.0 (24.6)
Cooked Colour										
Brightness, L*	76.8	77.4	77.2	76.9	76.4	77.3	76.7	77.2	76.3	77.3
Redness, a*	-0.29	-0.25	-0.33	-0.34	-0.29	-0.39	-0.29	-0.36	-0.79	-0.87
Yellowness, b*	17.3	17.4	17.8	17.8	17.0	16.6	17.4	17.0	17.7	17.3
Cook Time, minutes	13	13	12	12	13	14	12	13	11	11
Texture										
Thickness, mm	2.33	2.31	2.33	2.27	2.35	2.29	2.33	2.27	2.18	2.12
Resistance to compression, %	23.3	23.6	24.2	25.8	23.3	24.6	24.8	24.5	19.8	21.4
Recovery, %	23.2	24.9	22.7	24.4	23.3	22.5	23.1	24.1	18.8	20.0
MCS, g/mm²	18.5	18.3	17.7	18.3	18.7	17.2	18.3	17.9	14.9	15.6

Canada Western Malting Barley

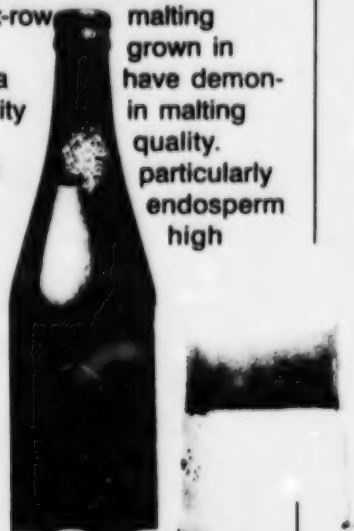
Western Canada is a producer of high-quality malting barley. In 1999, 60 per cent of the total barley acreage was seeded to malting barley varieties. The remaining 40 per cent was seeded to feed and hulless varieties suitable for livestock feed and human food. Two-row varieties are seeded on two-thirds of the malting barley area in Western Canada. Six-row malting barley varieties are seeded on the remaining one-third of the malting barley area.

The quality of malting barley produced in Western Canada is a reflection of the extensive breeding and research efforts undertaken to develop high-quality malting barley varieties agronomically suited to western Canadian conditions. Further evaluation is carried out to assess the malting and brewing qualities of promising varieties. Only those which have acheived satisfactory results in pilot scale malting and brewing tests are given full registration status by the Government of Canada. Further plant scale market development tests are carried out before varieties are "recommended" for general production.

The result of this extensive breeding, testing and research is that both the two-row and six-row malting varieties being grown in western Canada have demonstrated superiority in malting and brewing quality. They are noted particularly for their rapid endosperm modification, high enzyme activity, proper level of protein and superior diastatic power. In addition, the two-row varieties are known for their high extract levels.

As with malting barley from other origins, Canadian malting barley is marketed on the basis of buyer specifications. These specify the variety of barley to be shipped against a contract, required germination level, maximum protein content, minimum varietal purity, degree of kernel plumpness, maximum tolerances for damaged kernels as well as other quality factors. Special procedures have been established to ensure that the barley shipped against a contract meets contract specifications. These begin with the farmer, who is required to submit a representative sample of their malting barley for evaluation. If the sample is acceptable, the barley is selected and the farmer is asked to deliver this barley when needed for shipment. When the grower's barley is unloaded it is graded by the CGC. The CGC also provides analysis on the export vessel to confirm that it meets contract specifications.

Major barley growing areas in Western Canada



Canada Western

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Minimum* export sales contract quality specifications for Canada Western Malting Barley

Type	Two-Row	Six-Row
Moisture content max, %	13.0 - 13.5	13.0 - 13.5
Protein content max., %	12.5 - 13.5	12.5 - 13.5
Germination , 3 day min., %	95 - 96	95 - 96
Plump,% min. (>2.38 mm)	80 - 82	65 - 75
Thin,% max (< 1.98 mm)	3 - 4	3 - 4
1000 kernel wt ,g min	40	—

* Actual individual sales contracts may be better than these minimum specifications.

Malting & brewing quality data (typical commercial quality malt)[1]

Type	Two-Row	Six-Row
Malt		
Physical characteristics		
Malt yield, %	82.0	82.0
Friability, %	84.0	84.0
Chemical analysis		
Moisture content, %	4.0	4.0
Wort		
Fine-grind extract, %	82.0	80.5
Coarse-grind extract, %	80.5	79.0
F/C difference, %	1.5	1.5
β-Glucan content, ppm	100	100
Viscosity, cps	1.4	1.42
Soluble protein content, %	4.8	4.6
Ratio S/T, %	43.6	41.8
FAN, mg/L	180	180
Colour, °ASBC	1.7	1.7
Diastatic power, °L	120	130
α-Amylase, DU	54.0	50.0

[1] malt analyses different from these can be produced to customer specific demands.

Quality barley selected for export

Variety Origin of selected samples	Harrington Prairie Provinces[1]	Stein Sask.[2]	Excel Sask.[2]	Robust Sask.[2]	B1602 Sask.[2]	Foster Sask.[2]
Thousands of tonnes	42	84	85	60	46	16
Barley Physical Characteristics 1000 Kernel Weight, g.	40.1	43.1	36.4	37.7	34.1	38.4
Heavy grade, over 6/64" sieve, %	86.3	88.3	82.3	83.9	77.7	89.8
Intermediate grade, over 5/64" sieve, %	10.9	10.3	15.5	10.9	18.9	8.4
Chemical Analysis Moisture, %	10.9	12.3	11.9	10.8	11.9	10.7
Protein, %	11.8	11.0	11.2	12.1	11.5	11.1
Germination, %, 4 mL (3 day)	99	99	98	92	96	100
Germination, %, 8 mL (3 day)	90	83	83	54	84	76

[1] Weighted averages of Saskatchewan and Alberta
[2] Saskatchewan
[3] Moisture levels may not represent actual new crop moistures as survey samples are not collected nor stored in moisture-proof containers.

Malting Barley

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Canada Western Feed Barley

Canada Western Feed Barley has been found to be a highly effective ingredient in all animal feeds. Since it retains the hull, barley requires some processing before it is fed to increase nutrient digestibility. Barley should be ground for swine and poultry feeds and it should be coarsely ground or rolled for cattle feeds. Barley has an excellent essential amino acid composition compared to other grains. It has much higher lysine and similar amino acids digestibility compared to other grains.

Cattle rations
Barley is considered the main feed grain for beef and dairy rations and does not present any potential feeding problems. However, nutritionists suggest producers gradually introduce barley-based rations over a 7 to 10-day interval when switching from sorghum or corn-based rations.

Poultry rations
The development of commercial beta-glucanase preparations has expanded the use of barley in poultry rations by eliminating the problems related to beta-glucans. The beta-glucanase enzyme is added to the ration at the feed mill. As a result of the development of this enzyme, poultry producers in western Canada are now using barley as the sole grain ingredient in their broiler chicken grower and finishing rations and laying hen rations. In the past, the use of barley in poultry rations was limited due to the beta-glucan content. Poultry lack the necessary enzymes in their digestive systems to break down this carbohydrate, a problem that is corrected with the addition of commercial beta-glucanase.

If barley replaces corn in poultry rations, supplementary xanthophyll may be necessary to achieve the skin and yolk colour that is evident in corn-based rations.

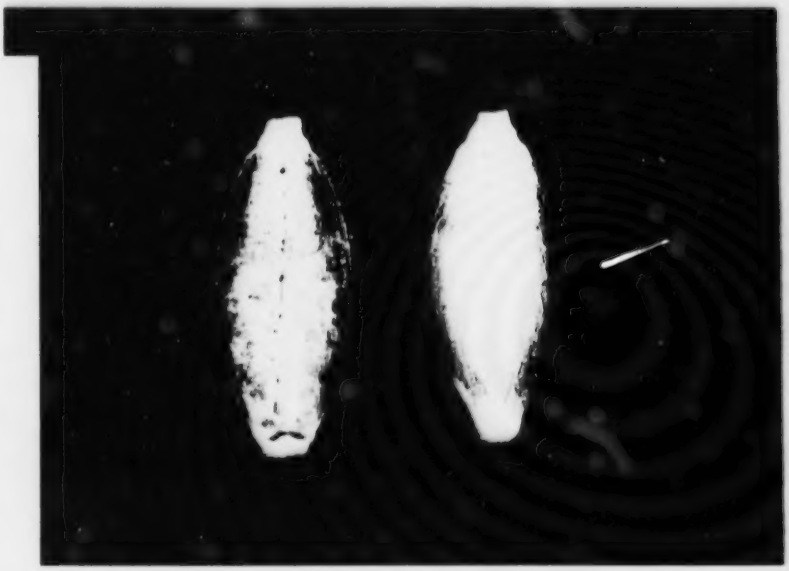
Hog rations
Barley is the basic grain used in western Canada for dry and nursing sow rations as well as in pig growing and finishing formulations. No nutritional precautions are necessary when feeding barley-based rations to pigs.

Sheep and goat rations
Barley is used as the main grain for both sheep and goats. The preferred processing method is to roll the grain to increase palatability and digestibility. Sheep may be fed whole barley. As with cattle, one should allow a gradual adaptation period of 7 to 10 days for full feeding on barley-based rations, particularly when finishing lambs in a feed lot environment.

Export standards for Canada Western Feed Barley

		Maximum limits of foreign material			
Grade name	Minimum test weight (kg/hL)	Large seeds	Wild oats	Other cereal grains	Total
1CW	63.0	0.2%	1.0%	2.5%	2.5%
2CW	57.0	0.2%	2.5%	8.0%	10.0%

Canada Western Hulless Barley



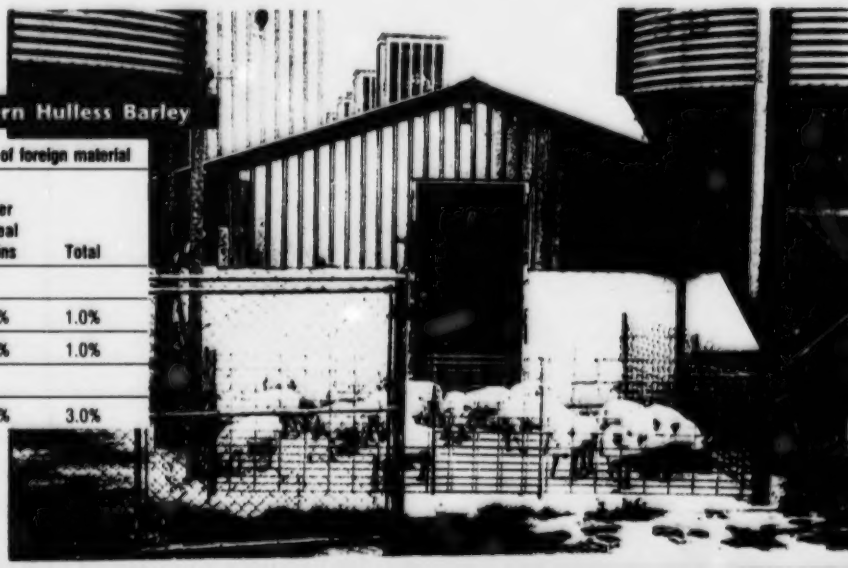
Canada also produces hulless barley for feed and food use. While this type of barley has been produced for several years in western Canada, production has recently increased to a level where commercial quantities maybe available for export. However, most of the production is used in domestic hog feed.

There are several advantages to using hulless barley in animal feeds. Because the barley kernel's hull is removed during harvesting, hulless barley has less fiber, resulting in more digestible energy than regular barley. Feeding energy levels are equal to or better than those of feed wheat.

In addition, hulless barley has a high test weight and high levels of protein, reducing the need for expensive protein supplements in livestock feed rations. Hulless barley's protein is also easily digested by livestock and provides high levels of several important amino acids.

Export standards for Canada Western Hulless Barley

			Maximum limits of foreign material		
Grade name	Minimum test weight (kg/hL)	Total adhered hulls	Wild Oats	Other cereal grains	Total
Select CW					
Two-Row	75.0	5.0%	0.5%	1.0%	1.0%
Six-Row	74.0	5.0%	0.5%	1.0%	1.0%
Standard					
CW Hulless	72.0	15.0%	1.0%	3.0%	3.0%



Methods and definitions

At the Grain Research Laboratory (GRL), unless otherwise specified,
- Analytical results for wheat are reported at 13.5% moisture content.
- Analytical results for flour and semolina are reported at 14.0% moisture content.
- AACC methods cited are from The American Association of Cereal Chemists (AACC): Approved Methods of the Association, Ninth Edition, 1995.
- ICC methods cited are those of the International Association for Cereal Science And Technology (ICC): ICC Standards: Standards Methods of the International Association for Cereal Chemistry, 6th Supplement, 1997.

Wheat & Flour

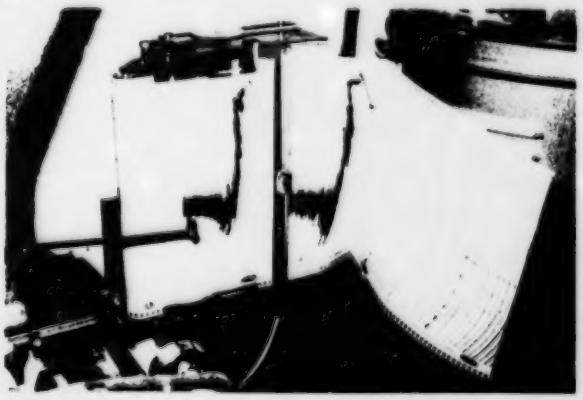
AGTRON colour
The AGTRON colour of flour and durum wheat semolina is determined using AACC Method 14-30. An AGTRON direct reading reflectance spectrophotometer is used.

Alveogram
ICC Standard Method No. 121 is followed, using the constant pressure Chopin Alveograph Model MA82.

α-amylase activity
The α-amylase activity of wheat and flour is determined by the method of Kruger and Tipples (1981), Cereal Chemistry 58:271–274.

Amylograph peak viscosity
Sixty-five grams of flour and 450 ml of distilled water are used with the Brabender amylograph and the pin stirrer. Other details are as in AACC Method 22-10. Peak viscosity is reported in Brabender units.

Ash content
To determine wheat or flour ash content, AACC Method 8-01 is used. Furnace temperature is set to 600° C.



Canadian short process baking test
The Canadian short process baking Test is carried out as described by Preston et al. (1982), Canadian Institute of Food Science and Technology Journal 15:29–36 using 150 ppm ascorbic acid as the oxidant. For this test loaves are produced from 200 g of flour in baking pans with cross-sectional dimensions similar to those of Canadian commercial baking pans. Loaf volume is reported for each 100 g of flour. Mixing energy is measured in watt-hours per kilogram (W-h/kg).

Dry gluten content-semolina
Dry gluten content is determined according to the Glutomatic System Operation manual.

Extensogram
This test is conducted using AACC Method 54-10 with the exception that the dough is not stretched at 90 minutes. Length is in centimetres, height is in Brabender units, and area is in square centimetres. The extensograph is set so that 100 Brabender units equal a 100-g load.

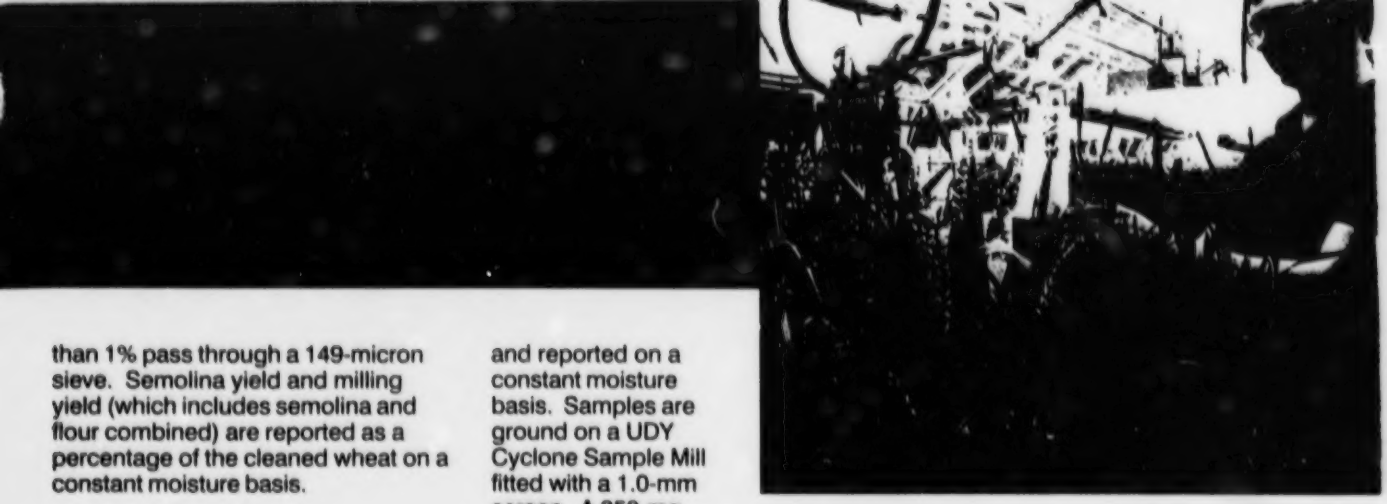
Falling number
The falling number is determined on a 7-g sample of ground wheat or semolina by AACC Method 56-81B. A 300-g sample of wheat is ground in a Falling Number Laboratory Mill 3100 according to ICC Standard Method No. 107.

Farinogram
This test is conducted using AACC Method 54-21A constant flour weight procedure with small bowl.
- Farinograph absorption is the amount of water that must be added to flour to give the required consistency. It is reported as a percent.
- Dough development time is the time required for the curve to reach its maximum height reported to nearest 0.25 min.
- Mixing tolerance index (MTI) is the difference, in Brabender units, between the top of the curve at the peak and the top of the curve measured 5 min after the peak is reached.
- Stability is defined as the difference in time, to the nearest half minute, between the point at which the top of the curve first intercepts the 500-BU line (arrival time) and the point at which the top of the curve leaves the 500-BU line (departure time).

For CWES, Farinograph absorption is determined at 63 rpm. Remaining quality parameters are measured at 90 rpm based on absorption obtained at 63 rpm. For additional details, see the Farinograph Handbook, AACC, 1960.

Flour yield
Wheat is cleaned, scoured and tempered overnight to optimum moisture as described by Dexter and Tipples (1987), Milling 180(7):16, 18–20. All millings at the GRL are performed in rooms with environmental control maintained at 21°C and at 60% relative humidity.
- Common wheat is milled on an Allis-Chalmers laboratory mill using the GRL sifter flow as described by Black et al. (1980), Cereal Foods World 25:757–760. Flour yield is expressed as a percentage of cleaned wheat on a constant moisture basis. For CWRS wheat, flour yield also is expressed at a constant ash content of 0.50%, as described by Dexter and Tipples (1989), Milling 182(8):9–11.

- Durum wheat is milled on a four stand Allis-Chalmers mill in conjunction with a laboratory purifier as described by Black (1966), Cereal Science Today 11:533–534, 542. The mill flow is described by Dexter et al. (1990), Cereal Chemistry 67:405–412. Semolina is defined as having less



than 1% pass through a 149-micron sieve. Semolina yield and milling yield (which includes semolina and flour combined) are reported as a percentage of the cleaned wheat on a constant moisture basis.

Grade colour
Flour grade color is determined using a Colour Grader Series IV (Satake UK, Stockport, UK) according to Flour Testing Panel Method No. 007/4 (Flour Milling and Baking Research Association 1991), and expressed in Satake International colour grade units. The lower the number, the brighter the colour.

Hard vitreous kernels
The percentage of hard vitreous kernels (HVK) is determined by examination of a sieved 25-g sample for the natural translucency associated with hardness. Kernels are classed as HVK or non-vitreous as defined in the Canadian Grain Commission's *Official Grain Grading Guide*, Chapter 4, Wheat.

Maltose value
Maltose value is determined according to AACC Method 22-15.

Moisture content (flour)
To determine the moisture content of flour, a 10-g sample is heated for one hour in a semi-automatic Brabender oven at 130°C.

Moisture content (wheat)
Industry Services determines the moisture content of flour, a 10-g sample is heated for one hour in a semi-automatic Brabender oven at 130°C.

Protein content (N x 5.7)
Protein content of the composite samples is determined by Combustion Nitrogen Analysis (CNA). Protein content (total nitrogen) is determined on a LECO Model FP-428 Dumas CNA analyzer calibrated with EDTA and reported on a constant moisture basis. Samples are ground on a UDY Cyclone Sample Mill fitted with a 1.0-mm screen. A 250-mg sample is analyzed as received (it is not dried before analysis). Moisture is determined by the AACC Method No. 44-15A (One stage air oven). Williams, P., Sobering, D. and Antoniszyn, J. 1998 Oct. 19. Protein testing methods at the Canadian Grain Commission. Proceedings of the Wheat Protein Symposium. Saskatoon, Sask. March 9 and 10, 1998 [conference paper online]. Available from: http://www.cgc.ca/Pubs/confpaper/Williams/ProteinOct98/protein1-3.htm

PSI (Particle size index)
PSI is a measure of the texture of a wheat kernel. AACC Method No. 55-30 is modified by using a UDY Cyclone sample mill fitted with a feed rate regulator and a 1.0-mm screen. A 10-g sample from 22 g of ground, blended wheat is sieved over a US Standard 200-mesh sieve for 10 minutes in a Ro-tap sieve shaker. The weight of throughs X 10 is recorded as the PSI.

Remix-to-peak baking test
The Remix-to-peak baking test is a modification of the Remix Baking Test of Irvine and McMullan (1960), Cereal Chemistry 37:603–613, as described in detail by Kilborn and Tipples (1981), Cereal Foods World 26:624–628. Dough is mixed to peak consistency at the second mixing stage.

SDS sedimentation
SDS sedimentation volumes are determined by a modified version of Axford and Redman (1979),Cereal Chemistry 56:582–584, using 3% SDS as described by Dexter et al. (1980) Can. J. Plant Sci. 60:25-29.

Semolina colour
Semolina colour is determined using a Minolta Spectrophotometer (Model CM-525i) and expressed as L*, which indicates lightness, a* which represents redness, and b* which represents yellowness (CIELAB colour space). Differences in particle size will have a significant effect on colour readings so it is essential, for comparative purposes, to use semolina samples that have comparable particle size distributions.

Spaghetti
Spaghetti is processed from semolina using the microprocessing method of Matsuo et al. (1972), Cereal Chemistry 49:707-711, and dried at 70°C using a computer controlled laboratory-scale dryer (AFREM, Lyon, France).

Spaghetti colour
Strands of spaghetti (5cm) are mounted on white cardboard, using double sided tape, for colour measurements. Spaghetti colour is determined using a Minolta Spectrophotometer (Model CM-525i) and is expressed as L* which indicates lightness, a* which represents redness, and b* which represents yellowness (CIELAB colour space).

Spaghetti cooking quality
Spaghetti cooking quality as measured by cooking quality parameter (CQP), is determined as described by Dexter and Matsuo (1977), Canadian Journal of Plant Science 57:717–727. Spaghetti firmness is determined using the JA.XT2 Texture Analyzer

Methods and definitions

following AACC Method 16-50, with a cross-wise cut through 10 strands of spaghetti cooked to optimum.

Speck count
Speck count is determined as described by Dexter and Matsuo (1982), Cereal Chemistry 59:63–69.

Sponge-and-dough baking test
The Sponge-and-dough baking test is based on a 4.5-hour 70% sponge system as described by Kilborn and Preston (1981), Cereal Chemistry 58:198–201. Ascorbic acid is used as the oxident and is added at a level of 40 ppm for straight grade flour and 20 ppm for patent flour. Loaves are produced from 200 g of flour in baking pans with cross-sectional dimensions similar to those of Canadian commercial baking pans. Loaf volume is reported for each 100 g of flour. Mixing energy is measured in watt-hours per kilogram (W-h/kg).

Starch damage, %
Starch damage is determined using AACC Method 76-31 Damaged Starch: Spectrophotometric Method. Starch damage is expressed as a percentage of flour weight. The method is also referred to as the MegaZyme method. Conversion factors for alternate methods are AACC 76-30A = 1.5662 * MegaZyme-0.338 p Farrand = 6.6092 * MegaZyme - 11.972

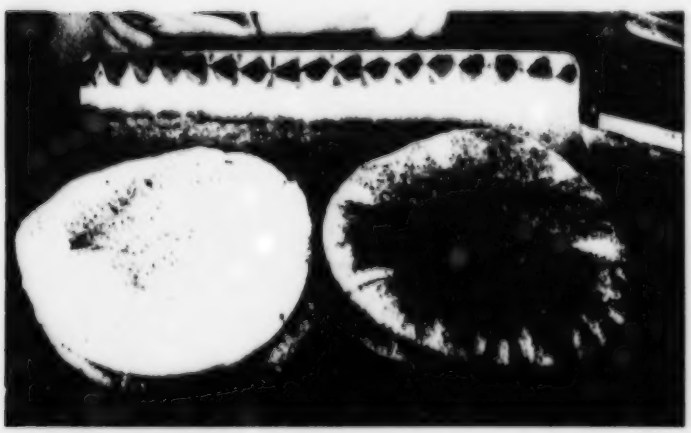
Test weight – Harvest Survey Data
Test weight is determined using the Schopper chondrometer equipped with the one litre container. The weight in grams of the measured litre of wheat is divided by 10. The result is reported in kilograms per hectolite (kg/hL) without reference to the moisture content.

Weight per 1000 kernels
Broken kernels and foreign material are handpicked from a sample to create a cleaned sample. The number of kernels in a 20-g subsample of the cleaned sample is then counted using an electronic seed counter.

Wet gluten content – flour
ICC Standard Method No. 137/1 is followed using the Glutomatic System Type 2200 with 80 micron metal sieves.

Wet gluten content and gluten index – durum semolina
Durum semolina wet gluten content is determined using AACC Standard Method 38-12, following the procedure for whole meal. The method gives lower values compared to the ICC Standard Method No. 137 used prior to August 1, 1998.

W-h/kg
Watt-hours per kilogram. A measure of mixing energy used in the Canadian short process baking test and sponge and dough baking test.



Noodles

Noodle colour is determined on a raw noodle sheet using a Hunterlab Labscan II spectrocolormeter using the CIE (1976) L*, a*, b* colour scale with a D65 illuminant.

L* is a measure of brightness.

a* indicates red-green chromaticity. Positive values indicate increased redness.

b* indicatesyellow-blue chromacity. Positive values indicate increased yellowness.

MCS represents the bite of the cooked noodle.

Resistance to compression, RTC% correlates with the noodle's firmness and chewiness.

Recovery, REC%, correlates with the noodle's firmness and springiness.

Texture measurements
(Oh, N.H.et al 1983, Cereal Chemistry) were carried out using a computer assisted Instron model 4201 Universal Texture Meter and represent the average of four replicate cookings in which each cook evaluated 5 sets of noodles. Maximum cutting stress (gm/mm2).

Tandem Bühler Pilot Mill using two Bühler mills linked as per Martin, D.G. and Dexter, J.E., 1991, AOM Bulletin p. 5855. 60% extratcion patent flours were prepared for noodle evaluation.

Malting Barley

Dockage and assortment
All samples are passed through a Carter dockage tester equipped with a No. 6 riddle to remove foreign material, and two slotted sieves to sort the barley. Heavy Grade barley is the material retained on a 6/64" (2.38 mm) x 3/4" slotted sieve. Intermediate Grade is barley that passes through the 6/64" x 3/4" sieve but is retained on a 5/64" (1.98 mm) x 3/4" slotted sieve.

Weight per 1000 kernels
A small sample of dockage-free, Heavy Grade barley is hand-picked to remove any residual foreign material. The weight of 500 kernels picked from this cleaned material is then measured and doubled.

Moisture content of malt (ASBC)
Moisture content of malt is determined on a ground sample at 104°C for 3 h in a convection oven.

Protein content
(N x 6.25) Protein content is predicted on Heavy Grade barley using NIR equipment that has been calibrated by Combustion Nitrogen Analysis (CNA). CNA is determined on a LECO Model FP-428 CNA analyser calibrated by EDTA. Samples are ground on a UDY Cyclone Sample Mill fitted with a 1.0-mm screen. A 200-mg sample is analysed as received (it is not dried before analysis). A moisture analysis is also performed and results are reported on a dry matter basis.

Germination energy
Germination energy is determined by placing 100 kernels of barley on two pieces of Whatman #1 filter paper in a 9.0-cm petri dish and adding 4.0 ml of deionized water. Samples are kept in the dark at room temperature. Germinated kernels are counted after 24, 48 and 72 h.

Water sensitivity
Water sensitivity is determined exactly as described for germination energy, except that 8.0 mL of deionized water is added to each petri dish. Water sensitivity is reported as the percentage of kernels that germinate in 8 mL, which can then be compared to the Germination Energy.

Acknowledgments
The Grain Research Laboratory acknowledges the cooperation and assistance of the following:

The grain companies and their primary elevator managers and western Canadian wheat producers for providing samples.

The Prairie Region office of Industry Services, Canadian Grain Commission, in grading all harvest survey samples.

Western Accredited Exporters

AgPro Grain Inc.
1104-201 Portage Avenue
Winnipeg, MB R3B 3K6
PHONE NUMBER (204) 989-3058
TELEFAX NUMBER (204) 949-0936

Agricore
220 Portage Avenue
Winnipeg, MB R3C 3K7
PHONE NUMBER (204) 954-1000
TELEFAX NUMBER (204) 954-1200
jmayo@agricore.com

Agro-Hall Ltd
4999 Ouest Rue Ste-Catherine West
Suite 455
Westmount, Montreal PQ H3Z 1T3
PHONE NUMBER (514) 369-2476
TELEFAX NUMBER (514) 369-5793
agrohall@attmail.com

Alfred C. Toepfer (Canada) Ltd.
709-167 Lombard Avenue
Winnipeg, MB R3B OV3
PHONE NUMBER (204) 925-0468
TELEFAX NUMBER (204) 956-0282
TELEX NUMBER 07-57170
toepfer@escape.ca

Benson-Quinn Company
27th Flr, 555 West Hastings St.,
Vancouver, BC V6B 4N6
PHONE NUMBER (604) 684-6141
TELEFAX NUMBER (604) 684-0861
TELEX NUMBER 04-53298

Bunge of Canada Limited
300 Dalhousie Street, P.O. Box 2537
Quebec City, PQ G1K 7R3
PHONE NUMBER (418) 692-3761
TELEFAX NUMBER (418) 692-0182
bunge.canada@bunge.com

Busch Agricultural Resources Inc.
7th Floor, 177 Lombard Avenue,
Winnipeg, MB R3B 0W5
PHONE NUMBER (204) 947-0800
FAX NUMBER (204) 957-0762

Canada Malting Co. Limited
1000-555 West Hastings Street,
Vancouver, BC V6B 4N4
PHONE NUMBER (604) 602-7050
TELEFAX NUMBER (604) 602-7051
dgrambsc@conagramalt.com

Cargill Limited
1620-1066 West Hastings Street,
Vancouver, BC V6E 3X1
PHONE NUMBER (604) 683-6531
TELEFAX NUMBER (604) 683-1094

ConAgra Grain, Canada
2100-360 Main Street
Winnipeg, MB R3C 3Z3
PHONE NUMBER (204) 942-5550
TELEFAX NUMBER (204) 943-4012
conagra@conagra-canada.com

James Richardson International Limited
2110-1050 West Pender Street,
Vancouver, BC V6C 3S7
PHONE NUMBER (604) 669-2520
TELEFAX NUMBER (604) 688-4598
gskura@jri.ca

Louis Dreyfus Canada Limited
1400, 333 11th Avenue SW
Calgary, AB T2R 1L9
PHONE NUMBER (403) 205-3322
TELEFAX NUMBER (403) 205-4408
keadyt@idcorp.com

Malchy Grain Company, Ltd
975-167 Lombard Avenue
Winnipeg, MB R3B 0V3
PHONE NUMBER (204) 944-9328
TELEFAX NUMBER (204) 947-2271
TELEX NUMBER 07-57805

Maple Leaf Mills International
3080 Yonge Street
Toronto, ON M4N 3N1
PHONE NUMBER (416) 480-8900
TELEFAX NUMBER (416) 480-8950
commodities@mlfi.com

N.M. Paterson & Sons Limited
22nd Floor - 333 Main Street
Winnipeg, MB R3C 4E2
PHONE NUMBER (204) 956-2090
TELEFAX NUMBER (204) 947-2386
dcouldwell@nmpsons.ca

Northern Sales Co. Ltd.
135 Lombard Avenue
Winnipeg, MB R3B 0T4
PHONE NUMBER (204) 949-1456
FAX NUMBER (204) 957-0350
TELEFAX NUMBER 07-57178
nsadmin@mb.sympatico.ca

Pacific Elevators Limited
4th Floor,-1111 West Hastings Street
Vancouver, BC V6E 2J5
PHONE NUMBER (604) 684-5161
TELEFAX NUMBER (604) 684-7106

Parrish & Heimbecker, Limited
1830-355 Burrard Street
Vancouver, BC V6C 2G8
PHONE NUMBER (604) 684-3261
TELEFAX NUMBER (604) 681-1502
turnerm@direct.ca

Range Grain Company Limited
960-360 Main Street
Winnipeg, MB R3C 3Z3
PHONE NUMBER (204) 943-6407
TELEFAX NUMBER (204) 947-0677

Saskatchewan Wheat Pool
2625 Victoria Avenue
Regina, SK S4T 7T9
PHONE NUMBER (306) 569-4411
TELEFAX NUMBER (306)569-4715
mark.nicholson@swp.com

United Grain Growers Limited
1155 Stewart Street
Vancouver, BC V6A 4H4
PHONE NUMBER (604) 254-4414
TELEFAX NUMBER (604) 254-3212
manania@unitedgrain.ca

XCAN Grain Pool Limited
1440-555 West Hastings Street
Vancouver, BC V6B 4N6
PHONE NUMBER (604) 687-6894
TELEFAX NUMBER (604) 684-2934
kdegroot@xcan.com

Eastern Accredited Exporters

ADM Milling Company
7 Higgins Avenue
Winnipeg, MB R3B 0A1
PHONE NUMBER (204) 925-2100
TELEFAX NUMBER (204) 947-1788

AgPro Grain
1104-201 Portage Avenue
Winnipeg, MB R3B 3K6
PHONE NUMBER (204) 989-3058
TELEFAX NUMBER (204) 949-0936

Agricore
220 Portage Avenue
Winnipeg, MB R3C 3K7
PHONE NUMBER (204) 954-1000
TELEFAX NUMBER (204) 954-1200
jmayo@agricore.com

Agro-Hall Ltd
4999 Ouest Rue Ste-Catherine West
Suite 455
Westmount, Montreal PQ H3Z 1T3
PHONE NUMBER (514) 369-2476
TELEFAX NUMBER (514) 369-5793
agrohall@attmail.com

Alfred C. Toepfer (Canada) Ltd.
709-167 Lombard Avenue
Winnipeg, MB R3B 0V3
PHONE NUMBER (204) 925-0468
TELEFAX NUMBER (204) 956-0282
TELEX NUMBER 07-57170
toepfer@escape.ca

Benson-Quinn Company
2180-360 Main Street
Winnipeg, MB R3C 3Z3
PHONE NUMBER (204) 982-7932
TELEFAX NUMBER (204) 942-8077
kevinc@mb.sympatico.ca

Bunge of Canada Limited
300 Dalhousie Street, P.O. Box 2537
Quebec City, PQ G1K 7R3
PHONE NUMBER (418) 692-3761
TELEFAX NUMBER (418) 692-0182
bunge.canada@bunge.com

Busch Agricultural Resources, Inc.
7th Floor, 177 Lombard Avenue
Winnipeg, MB R3B 0W5
PHONE NUMBER (204) 947-0800
FAX NUMBER (204) 957-0762

Canada Malting Co. Limited
1000-555 West Hastings Street
Vancouver, BC V6B 4N4
PHONE NUMBER (604) 602-7050
TELEFAX NUMBER (604) 602-7051
dgrambsch@conagramalt.com

Cargill Limited
300-240 Graham Avenue
Winnipeg, MB R3C 4C5
PHONE NUMBER (204) 947-0141
TELEFAX NUMBER (204) 947-6444
http://www.cargill.com

ConAgra Limited
2100-360 Main Street
Winnipeg, MB R3C 3Z3
PHONE NUMBER (204) 942-5550
TELEFAX NUMBER (204) 943-4012
conagra@conagra-canada.com

James Richardson International Limited
2500 - One Lombard Place
Winnipeg, MB R3B 0X8
PHONE NUMBER (204) 934-5416
TELEFAX NUMBER (204) 956-0287
TELEX NUMBER 07-57706
tjames@jri.ca

Louis Dreyfus Canada Limited
1400, 333 11th Avenue SW
Calgary, AB T2R 1L9
PHONE NUMBER (403) 205-3322
TELEFAX NUMBER (403) 205-4408
keadyt@idcorp.com

Malchy Grain Company Ltd.
975-167 Lombard Avenue
Winnipeg, MB R3B 0V3
PHONE NUMBER (204) 944-9328
TELEFAX NUMBER (204) 947-2271
TELEX NUMBER 07-57805

Maple Leaf Mills International
3080 Younge Street
Toronto, ON M4N 3N1
PHONE NUMBER (416) 480-8900
TELEFAX NUMBER (416) 480-8950
commodities@mlfi.com

N.M. Paterson & Sons Limited
22nd Floor - 333 Main Street
Winnipeg, MB R3B 0V5
PHONE NUMBER (204) 956-2090
TELEFAX NUMBER (204) 947-2386
dcouldwell@nmpsons.ca

Northern Sales Co. Ltd.
135 Lombard Avenue
Winnipeg, MB R3B 0T4
PHONE NUMBER (204) 949-1456
TELEFAX NUMBER (204) 957-0350
TELEX NUMBER 07-57178
nsadmin@mb.sympatico.ca

Parrish & Heimbecker, Limited
700-360 Main Street
Winnipeg, MB R3C 3Z3
PHONE NUMBER (204) 956-2030
TELEFAX NUMBER (204) 943-8233
jheimbkr@parheim.mb.ca

Range Grain Company Limited
960-360 Main Street
Winnipeg, MB R3C 3Z3
PHONE NUMBER (204) 943-6407
TELEFAX NUMBER (204) 947-0677

Saskatchewan Wheat Pool
2625 Victoria Avenue
Regina, SK S4T 7T9
PHONE NUMBER (306) 569-4411
TELEFAX NUMBER (306) 569-4715
mark.nicholson@swp.com

United Grain Growers Limited
T.D. Center, Box 6600
201 Portage Avenue
Winnipeg, MB R3C 3A7
PHONE NUMBER (204) 944-5406
TELEFAX NUMBER (204) 947-1779
rcaners@unitedgrain.ca

XCAN Grain Pool Limited
1200-201 Portage Avenue
Winnipeg, MB R3B 3K6
PHONE NUMBER (204) 949-4500
TELEFAX NUMBER (204) 949-1057
TELEX NUMBER 07-57857
kmatchett@xcan.com

International Exporters

Nissho Iwai American Corporation
1211 SW 5TH Avenue, Suite 2200
Portland, Oregon 97204 U.S.A.
PHONE NUMBER (503) 220-2216
TELEFAX NUMBER (503) 241-0302
TELEX NUMBER WU 360529
sato_s@niac.com

Mitsubishi International Corporation
1211 SW 5TH Avenue, Suite 2800
Portland, Oregon 97204 U.S.A.
PHONE NUMBER (503) 227-3271
TELEFAX NUMBER (503) 241-8109
TELEX NUMBER PTL 360570
masao_nishiiri@micusa.com

The Canadian Wheat Board
Winnipeg, Manitoba (Head Office)
423 Main Street
P.O. Box 816, Stn. M.
Winnipeg, Manitoba
Canada R3C 2P5
Phone (204) 983-0239
Fax (204) 983-3841
Telex 07-57801
Web site http://www.cwb.ca

Regina, Saskatchewan
424 McDonald Street
Regina, Saskatchewan
Canada S4N 6E1
Phone (306) 751-2690
Fax (306) 751-2691

Vancouver, British Columbia
650 Marine Building
355 Burrard Street
Vancouver, British Columbia
Canada V6C 2G8
Phone (604) 666-2992
Fax (604) 666-0293
Telex 04-508862

Tokyo, Japan
3rd Floor, Toranomon No. 11 Mori Bldg.
6-4, Toranomon 2- chome
Minato-ku
Tokyo 105-0001, Japan
Phone 011-81-3-3519-2288
Fax 011-81-3-3519-2287

Beijing, China
Suite 708, Tower B
Beijing COFCO Plaza
8 Jianguomen Nei Street
Beijing, China 100005
Phone 011-86-10-6526-3908
Fax 011-86-10-6526-3907

The Canadian Grain Commission
1404-303 Main Street
Winnipeg, Manitoba, Canada R3C 3G8
Telephone (204) 983-2770
Telex 05-34777
(enter YFJ2761 on line one of message)
Fax (204) 983-0724
Web site http://www.cgc.ca

Canadian Wheat Board

Visit the CWB Web site at http://www.cwb.ca

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